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TRANSPORT and SOCIETY

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The fundamental purpose of transport is often forgotten. It is for people to have access to other people and goods. Increasingly over the past two hundred years the emphasis has shifted from a simple decentralised community life where almost all journeys were within walking distance to a more complex community where workplaces, homes and leisure facilities are separated and concentrated. Transport has frequently been used to encourage this separation. In the 1920s the Metropolitan Railway encouraged commuting from the North West London suburbs—'metroland' as it became known—by buying land around its stations and indulging in speculative property development, thereby creating a permanent market for their railway. The need to stimulate employment in development areas led to a policy of improving the 'infrastructure', one of the vogue words of the 1960s. This meant a regional road building programme to make the cost of road transport cheaper. It has since been shown by a government statistician that the objective of expanding employment could have been better achieved by a direct employment subsidy, a 5% labour subsidy being as effective as a 35% improvement in communications. But it has been shown that these improvements in communications, and consequent public transport reductions have meant a decrease in mobility for many people. Present transport problems largely result from a shift in emphasis from transport as a means of providing access to people and goods to cheaper and more transport as an end in itself. This increasing self-importance of transport is illustrated by the tendency to replace the word 'transport' by 'transportation'—a word formerly reserved for a one way journey to Botany Bay.

1. HISTORICAL OUTLINE

It is usual when writing about transport to concentrate

on the more impressive major projects, like the Victorian railway building mania, the motorway programme, and Concorde, because they had complex social and environmental consequences; it is taken so far, however, as to omit what for most people remains the most important form of transport. From earliest prehistory until the present age of mechanised transport the majority of journeys have been by foot.

Although the development of transport has meant that more people are able to travel faster and further, the short journey on foot remains the most important in Britain.

In Celtic Britain networks of footpaths and roads were established connecting farms and villages, the precursors of the modern network of paths. Long distance journeys were made on 'ridgeways' because the higher ground was easier and safer. The Romans established a planned network of roads to supply their towns and forts. These roads are still the basis of the present road system and the Saxons distinguished between the Roman 'streets' like the Watling Street and 'ways' like the Icknield Way, which had grown up through usage.

Britain, with her long, indented coastline, is well suited for coastal shipping, which superseded road transport for many purposes in the middle ages. When the Romans conquered Wales they built roads to supply their forts; Edward I, in his campaign, built castles on the coast with watergates so that they could be supplied by sea. By the time of Chaucer 'sea coal' was being shipped from Tyneside to London and in the reign of Elizabeth it was estimated that 75% of all shipping was coastal trade. Indeed coal traffic was important enough to be taxed to pay for the rebuilding of St. Paul's after the Great Fire of London. The rivers were used as an extension of the sea for coastal shipping, especially for the heaviest goods. "Even inland towns like York,

Gloucester, Norwich, Oxford, Cambridge were to a large extent ports on rivers.¹¹ Roads were largely used for distribution of freight, although in Elizabethan times they grew busier and the number of Inns increased. However road freight remained expensive and in the 17th century coal when disembarked 3 miles from Taunton was 18 pence for 2 bushels but in Taunton the same amount cost 2 shillings. The upkeep of the road system was borne by the parish, and there was a natural reluctance to pay for the wear and tear on heavily used main roads when they brought little benefit to the parish. The condition of roads deteriorated as their use, particularly by heavy waggons, increased; and by the reign of Anne many roads were too soft for waggons, and pack horses had to be used. In the latter half of the 16th century the stage coach became important and most large towns had coaches to London. A 'flying coach' to Oxford was started in 1669, taking only one day.

The deterioration of the roads led to the creation of Turnpike Trusts. In 1695 the London to Colchester road was granted a Turnpike Act, which empowered the Justices to collect tolls to pay for the maintenance of the road. Within a few years the administration of Turnpikes was put in the hands of an independent Trust.

The Turnpike Trusts produced by the 1820s a national network of roads, and speeds of up to two and three times faster than before were now possible, even though "the scope given to the trustees to administer them well or badly, or to put money into their own pockets while doing so, was clearly not insignificant even in an age full of such opportunities."² John MacAdam and Thomas Telford were among the well-known engineers employed by Turnpike Trusts and they pioneered a scientific approach to road building.

The improvement of the road system produced an increase in traffic, and revenue from stage coach duty rose by 27% between 1805 and 1814. The increase in stage coach traffic encouraged other industries and passengers on long distance coaches were subject to more or less subtle forms of extortion by innkeepers and robbery by highwaymen.

The 18th century saw the improvement for navigation of many rivers, like the Medway, the Mersey and the Wear. The scope for further improvement of inland navigation was limited until the construction by James Brindley of the Bridgewater canal in 1761. This canal, which reduced the price of coal in Manchester from 7d to 3½d a hundredweight conclusively demonstrated the advantages of water transport and led to the construction of 3,000 miles of improved inland waters by 1830.

The adoption of the steamship in the 1820s led to an expansion in both passenger and freight traffic by coastal shipping. Although steamers were usually slower than a coach for passenger journeys they were cheaper (with no hidden extras) and more comfortable. The arrival of the first screw collier in the Thames (1852) led to an expansion in coal traffic which continued until the turn of the century.

In 1830 the Liverpool to Manchester Railway opened, the first passenger railway to use steam engines exclusively. Its success in paying a regular 9¼% dividend produced the first boom in railway construction from 1833 to 1839. The railway mania of 1844-49 with over 700 companies being sanctioned by Railway Acts founded the modern railway system and by 1852 there were 7,500 miles of railway network. During the next 60 years gaps in the system were filled and a large number of branch lines were built bringing the total up to 23,441 miles by 1912.

The dramatic increase in railway mileage revolutionised English society. The railways were cheaper and quicker than either road or coastal steamer and between 1840 and 1870 there was a twenty-fold increase in train passengers. After Gladstone's Railway Act of 1844 every company had to provide one train a day in each direction for third class passengers at one penny per mile and there were few who could not afford a trip to the seaside. Resorts like Margate and Clacton flourished.

The railways were slower to dominate goods traffic largely because water transport was already established as a cheap carrier; however, by the early 1850s the volume of goods by rail exceeded that by canal. The railways seized much of the canal traffic by a mixture of business efficiency and ruthless political skulduggery.

The relatively fast service provided for goods traffic by the railways meant that almost all the country could enjoy fresh fish for the first time, but it also meant the concentration of the fishing industry at those ports which were railheads. The railways helped the centralisation of industry and led to the urbanisation of England in 90 years; whereas in 1830 75% of the people lived in rural areas, by 1920 75% lived in urban areas.

What MacAdam called the 'calamity of the railways' bankrupted the Turnpike Trusts and the upkeep of the road system once again fell to the parishes. Although the main road system deteriorated the secondary road system remained in fairly good repair, partly because of the need to distribute and collect goods to and from railway stations. The increasing urbanisation caused an increase in horse buses and trams and in spite of the displacement of stage coach traffic in the railway era the price of horses rose. However the horse bus was quite expensive and poorer people often preferred to walk, even quite long distances. Trams came into use because less horsepower was needed to haul a tram than was needed for a bus.

The Rover Safety Bicycle, first made in 1885, established a craze for cycling in the late 1880s. The boom in cycling produced many complaints about dust and cyclists formed a pressure group to lobby for the spraying of roads with tar to reduce dust. Cycling reached its peak in the 1930s and declined thereafter.

With the increasing urbanisation of Britain, electric tramways (first in use at Blackpool in 1885) provided the cheapest ever form of urban transport. There were twice as many passenger journeys by tram as rail just before the First World War (1913-14), 74 journeys for every person living in the United Kingdom. The sharp

decline in tram journeys after 1927-8, in striking contrast to many European cities, was largely due to a trend-setting decision by the newly nationalised London Passenger Transport Board in 1931 to reverse the London County Council's tram modernisation programme and to convert to trolley buses.

Between the wars the number of cars increased from just under 200,000 in 1920 to 2 million by 1939. This was the golden age of motoring, and the freedom of car ownership was not inhibited by too many other motorists or for that matter by safety regulations. Until 1930 the number of motor cycles increased rapidly but the 1930s saw a slow decline in their numbers.

More important for most people was the large increase in the number of buses on the roads. Almost every centre of population, however small, had a bus service. By 1933 the annual number of bus and tram journeys was 9,450 million. During the 1930s the average man was more mobile than he has ever been, either before or since. The train, bus and bicycle provided almost everybody with the opportunity to travel both quickly and cheaply.

Since the war, car ownership has increased from 0.03 cars per head in 1945 to 0.25 in 1975. In 1973 private road transport accounted for 80% of all passenger mileage in Great Britain. This change has caused a substantial decline in the service provided by bus and train. By 1973 43% of the railway passenger stations and 29% of the route mileage open in 1963 had been closed, and passenger mileage had declined by 4% over the same period. The number of miles run by bus services declined by 17% and bus passenger mileage dropped by 19%.

The construction of motorways, 1,000 miles by 1971, and the relaxation of restrictions on heavy goods vehicles have caused a large increase in the number of heavy lorries. The canals lost most of their remaining traffic between the wars and although the railways and coastal shipping have tended to retain their traffic, most of the increase in freight has gone by road. 53% of freight ton mileage went by road in 1963, rising to 65% by 1973. The car and the heavy lorry have since the war come to dominate large scale movement in Great Britain.

2. TRANSPORT ADMINISTRATION AND FINANCE

The present structure of transport in Britain is extremely complex and to a large extent reflects the historical growth of transport. Most forms of transport are more or less directly controlled by the Secretary of State for the Environment but important areas like civil aviation, coastal shipping and the motor industry are the responsibility of the Secretaries of State for Trade and Industry.

The collapse of the Turnpike Trusts after the coming of the railways led to the Public Health Act of 1872 and the County Councils Act of 1888 which made major roads the responsibility of County Councils and secondary roads the responsibility of local councils.

The Local Government Board later to become the Ministry of Housing and Local Government was empowered to make grants of up to 50%. Lloyd George's 1909 budget set up the Road Fund, which was financed by the proceeds of a petrol tax and administered by the Roads Board, which gave grants to local authorities. After the First World War, Lloyd George intended to set up a Ministry of 'Ways and Communications' to incorporate the function of the Roads Board and those of a nationalised railway network, direct control having proved so successful during the war. In the face of considerable opposition from road interests, who feared railway domination, Lloyd George compromised and instead amalgamated the 123 pre-war railway companies into just four. Thus the main function of the new Ministry of Transport, which was formed in 1919, became the administration of the Road Fund, which was now financed through the motor vehicles' road fund licence. The Ministry of Transport had the direct responsibility for the construction and maintenance of roads with only some residual responsibility for the other forms of transport. Important additional responsibilities were gained under the 1930 Road Traffic Act (Bus Licensing) and the 1934 Road Traffic Act (Driving Tests and Road Safety Measures).

The railways were finally nationalised in 1947 along with most docks, inland waterways and road haulage. Together with London Transport, the nationalised transport undertakings were organised under the British Transport Commission. This attempt to integrate transport failed in 1953 when road haulage was denationalised. The residue of the British Transport Commission (mainly the railways) lasted until 1961. The 1968 Transport Act established 6 nationalised transport industries: the British Railways, British Waterways and British Transport Docks Boards, the National Freight Corporation to control nationalised road haulage and the National Bus Company to administer the nationalised buses. In Scotland all publicly owned road transport, both road haulage and buses, are managed by the Scottish Transport Group.

Under Parts II and III of this Act, 6 Passenger Transport Authorities were set up in certain urban areas with a specific obligation to integrate transport facilities in their area. The PTAs have the power to subsidise uneconomic services. In 1969 the responsibility for London Transport was transferred from the Government to the Greater London Council.

Although the National Freight Corporation is a major road haulage operator, having some 5% of the nation's freight traffic, the majority of the road haulage industry remains in private hands. Apart from a few remaining private operators, almost all Britain's buses are in public ownership; in urban areas they are operated by Municipalities, PTAs and London Transport and in other urban and rural areas by the National Bus Company. The NBC acts as a holding company for the more familiar local operators like London Country, Crosville and Midland Red.

The Department of the Environment has overall

responsibility for road planning, maintenance and construction in England. Since the 1968 Transport Act detailed local planning and construction of the 30,000 miles of principal roads and motorways is done by the Department of the Environment's local road construction units. Maintenance and new construction of the rest of the 180,000 miles of roads is the responsibility of local authorities, notably county councils.

The chairmen of British Railways, the National Freight Corporation and the National Bus Company report to the Minister of Transport, within the Department of the Environment. Road planning in Wales and Scotland is the responsibility of the Secretaries of State for Wales and Scotland respectively and in addition the Secretary of State for Scotland has responsibility for the Scottish Traction Group.

The nationalised docks (British Transport Docks Board) through which passes 23% of all ports traffic are the responsibility of the Minister for Transport and the remaining ports and docks are owned by a mixture of Trusts and local authorities. Coastal shipping is the responsibility of the Department of Trade and Industry. The nationalised waterways (British Waterways Board) come under the Minister for Sport within the DoE but there are a number of important inland waterways controlled by other public authorities, privately or by trusts, like the River Thames and the Manchester Ship Canal.

There are two major domestic airlines, British European Airways, now part of British Airways, and the privately owned British Caledonian. Ministerial responsibility is with the Department of Trade. Major airports are controlled by the Civil Aviation Authority, which also comes under the Department of Trade but a number of regional airports are municipally owned.

The motor vehicle industry was until recently almost entirely in private ownership with the exception of a government interest in bus manufacture through the 'national' bus factory at Workington (jointly owned by the National Bus Company and British Leyland). Just four companies have 99% of the British car market, excluding imported vehicles. Ford, Chrysler and Vauxhall are American owned, Vauxhall by General Motors, and British Leyland following its collapse in 1975 is now publicly owned. The Department of Industry has overall responsibility.

The majority of car owners are private individuals, but it has been estimated that business users buy between 40 and 60% of all new cars. In addition to road haulage contractors there are the 'own account' operators, who use their own lorries to distribute their own goods. About 36% of the lorries on the road are own account.

INVESTMENT

The Treasury's investment criteria is that public investment should earn a 10% rate of return and this applies to nationalised transport industries. Road investment—which produces no direct financial return—is only

required to show a 10% rate of return in a cost benefit analysis.*

The cost benefit analysis is extremely arbitrary and based on traffic flows forecast 15 years after construction. The benefits from this sort of analysis increase in proportion to the traffic forecast and no account is taken of most of the social and environmental costs. So long as traffic is forecast to increase there can be few roads which will not show a 10% rate of return. British Rail have estimated that their 1973 improvements at Peterborough on the East Coast main line which saved 5 minutes on each passenger journey would show a social rate of return of 24% in 1974 and 57% in 1978, over and above the commercial rate of return required for the approval of railway investment.

This imbalance in investment criteria for roads and all other transport investment has caused a large and persistent bias in favour of road construction. The imbalance is caused partly by a large and well funded road lobby unimpeded until recently by any effective counterbalance, and partly by a bias in the institutionalisation of transport. Normally, one sectional interest within government counterbalances another, like the Army, Navy and Air Force in the Ministry of Defence but there is no effective counter-balance for the road planner within the DoE.

This has led to a remarkable stability in government finance for road building. Until the cutbacks in road finance caused by the energy crisis at the end of 1973, money spent on road building had increased steadily and cutbacks were almost unknown. By contrast, railway investment has gone through several expansions and contractions. This stability in road investment has been a major cause of the increasing dominance of road transport since the war.

The Local Government Act 1972, which came into force in 1974, went a long way towards rectifying the imbalance in local government, and local authorities are now empowered to subsidise and invest in public transport, and to construct and maintain roads. For the first time local authorities can plan for all forms of public transport in their area. The local authority transport plans (the Transport Policies and Programmes) are submitted to the DoE for approval and they attract a bulk grant from the DoE towards the local authority's expenditure. A comparable degree of national transport co-ordination is still lacking.

RESEARCH AND DEVELOPMENT

The Transport and Road Research Laboratory (formerly the Road Research Laboratory) carries out research and development into roads and traffic. With its change of name in 1971 its brief was widened to include some research into other forms of transport, one product of

*There have been certain exceptions to this. The Victoria Line was justified after a Cost Benefit Analysis and it is doubtful if any underground railway could be justified on strictly economic grounds.

which was the mini-tram (see p. 15). Research into motor vehicles is carried out partly by the manufacturers themselves and partly by the joint government/industry sponsored Motor Industry Research Association. Railway research, like the high speed train and the advanced passenger train is carried out by British Rail with government aid. The DoE sponsors some bus research, both directly and through the TRRL.

3. THE RESEARCH, ENVIRONMENTAL AND SOCIAL CONSEQUENCES OF TRANSPORT

The effects on society and the environment which can result from changes in the supply or quality of transport are rarely foreseen before the event. Some of these effects are obviously good, some bad, but the majority are the subject of considerable controversy.

The railways changed England from a rural society to an urbanised one, with high density towns and slums. Even the faster stage coaches, resulting from the road improvements of the turnpike era, caused complaints of rural depopulation. The motor bus, according to Aldous Huxley, did more to rid England of the village idiot in the 1930s than all the lectures on eugenics. Car ownership has resulted in low density suburban sprawl and ribbon development which is difficult to serve by public transport. Ironically, recent public transport closures have caused localised rural depopulation and higher car ownership. As car ownership and road traffic have increased, so have the environmental and social costs of transport, but the most immediately pressing problem is the high resources cost of transport, and in particular, just how long road transport can be run on oil.

ENERGY

Road transport, particularly the car and the lorry, is a very inefficient user of energy. Domestic transport in the UK used about 14% of the total energy consumption and 23% of imported oil in 1971. Almost all the energy consumed by transport is refined oil with the exception of electric transport which may be powered indirectly by coal, water, oil or nuclear energy. Cars and motor-cycles use nearly half the energy consumed by transport in this country and road freight a further quarter. Estimates of the efficiency of various forms of transport in 1971 in the U.K. are:—

Passenger miles per gallon of petrol equivalent

Buses	117
Railways	61-91
Cars	60
BEA domestic services	41

The theoretical efficiency of these forms of transport is considerably greater but the actual efficiency achieved depends on the load factor. Thus a car with four passengers is twice as efficient as a car with two passengers. The table shows the maximum theoretical efficiency of passenger transport, roughly in descending order of efficiency.

Units: Passenger miles per unit of energy equivalent to one gallon of petrol

Bicycle	1650
Double deck bus	550
Inter city train	320-530
Inter city coach	510
Suburban electric train	410
Walking	370
Small motor cycle	130
Average UK car	108
Jet aircraft	49-51

(Table assumes a 100% load factor)

The source of the energy consumed is important. Energy consumed by walking and cycling is obtained from food which is a renewable resource (although present methods of food production require large inputs of fossil fuel). Electricity can be obtained from renewable sources like water and solar power. Oil and coal are not renewable but coal is more plentiful in Great Britain than oil. Oil is road transport's only source of energy at present although it is theoretically possible to run road transport on liquid fuels derived from coal, liquid hydrogen, methanol or batteries. These energy sources are likely to be considerably more expensive than petrol is at the moment.

The following table shows the 1971 efficiencies of freight transport, together with the theoretical efficiencies.

Units: Ton miles per unit of energy equivalent to one gallon of petrol

Railways	56-112
Inland and coastal shipping	99
Road freight	27
Theoretical efficiency	
Diesel train 600 tons	310
BACAT barge 420 tons	230
AEC mandator 21 tons	77-130
Ford van 5½ tons	38-56

The main factors affecting the energy consumption are:

- 1) weight; a 10% increase in weight will increase energy consumption by 8%
- 2) the load factor: heavier lorries are more efficient than lighter lorries because when fully loaded the freight carried forms a larger proportion of the total weight
- 3) the frictional loss of energy due to vehicle movement, this being greater for rubber wheels on roads than for steel wheels on rails or vessels in water
- 4) the thermal efficiency of the engine, about 20% for a petrol engine but about 85% for an electric engine,
- 5) the thermal efficiency of power stations, about 28% in Britain, and
- 6) the speed of the vehicle, since energy consumption increases with speed.

The energy consumed in the manufacture of vehicles is considerable and it has been estimated that the manufacture of a car uses 422 gallons of petrol equivalent, about one third more than the annual petrol consumption of a car.

LAND USE

Transport is also a significant user of land. Roads use land less efficiently than railways and a four track railway (60 foot wide) can carry more passengers and freight than a six lane motorway (130 foot wide). Completion of the inter-urban roads programme would require an area one tenth of the size of Oxfordshire and the aggregates (sand, gravel, limestone etc.) used in road construction cause a significant land loss. Road transport also consumes land by encouraging low density development.

Most materials used in transport are not likely to become scarce for several centuries, with the exception of copper and zinc. An important cause of waste in transport is the incomplete recycling of metal from scrapped cars, in-built obsolescence and rapid corrosion, which the DTI thought could be reduced at "negligible cost". The recycling of other transport vehicles is virtually complete.

THE ENVIRONMENTAL COSTS

(1) Noise

Road traffic noise affects more people than any other source, although both railway and aircraft noise are significant causes of disturbance. The 1961 London Noise Survey found that 36% of people in Inner London were disturbed by road traffic noise at home, 9% by aircraft and 5% by railways. In 1970 nearly 10 million people were subject to L_{10} traffic noise levels of above 65dB(A).*

According to the DoE road traffic noise has worsened since 1970. Since the 1973 Land Compensation Act compensation is paid to those who suffer more than 68dB(A) as a result of new road construction, but not to those already subject to this level. Wilfred Burns, the DoE's Chief Planner, has estimated that by 1980 over two thirds of the urban population will be subject to noise levels in excess of 65dB(A).

The most important contributor to traffic noise is the heavy goods vehicle. The GLC have estimated that with a traffic flow of 1,200 vehicles per hour, an increase in the proportion of heavy vehicles from 20% to 50% increases traffic noise from 69 to 76dB(A), which is roughly half.

(2) Vibration

Closely related to noise, are the vibrations from traffic transmitted by the ground. These can damage buildings and the Czechoslovakian Research Institute for Building and Architecture found that traffic flows equivalent to 7,440 heavy vehicles per day would reduce the life of a modern building by 50 years. Vibration damage was linked to vehicle weight and a light lorry was

thought to cause only 40% as much damage as a heavy lorry.

(3) Air and Water Pollution

Air pollution is the major cause for concern: but in 1969 900,000 tons of oil were poured into the world's rivers and seas and a further 450,000 tons of lubricating oil, much of which was from motor vehicles. Diesel engines are much cleaner than petrol engines, when properly adjusted, but frequently an (illegal) adjustment is made to increase the power which causes black smoke to be emitted and increases pollution. Because of their relatively large throughput of fuel, heavy lorries produce significant amounts of certain pollutants, chiefly nitric oxide and carbon monoxide.

Motor vehicles are the largest single source of all air pollution in the United States, contributing 86 million tons out of a total of 142 million in 1965. The most serious single cause of transport pollution is the motor car. Due to its low thermal efficiency the petrol engine produces considerable volumes of carbon monoxide, unburnt hydrocarbons and carbon particles as well as nitric oxide and lead. It has been estimated that in 1968 seven million tons of carbon monoxide, 1.1 million tons of unburnt hydrocarbons, 400,000 tons of nitrogen oxides (mainly nitric oxide) 125,000 tons of particles, 20,000 tons of aldehydes and 10,000 tons of lead were emitted by motor vehicles. It is difficult to assess the extent of the effect of motor vehicles on human health or the environment because combinations of pollutants can be more damaging than the simple sum of the components and because the long term effects of low levels are little known. Carbon monoxide is a lethal poison, but concentrations in city streets in Britain have never reached any known danger level. However, it is the opinion of the President of the Institute of Biology that present levels should not be tolerated even if they cannot be proved to be dangerous. The Road Research Laboratory believed that nitrogen oxides could be more of a danger than carbon monoxide. Unburnt hydrocarbons are probably relatively harmless, but it is known that one of these, ethylene, even at extremely low levels, can damage sensitive plants. Lead is added to petrol as lead tetra ethyl to increase the octane rating of petrol (an 'anti-knock'). It is emitted as a metallic lead aerosol and in its highest concentrations falls out within 100 yards of a road. Samples taken around Spaghetti Junction in Birmingham have shown dramatic and possibly dangerous blood-lead levels.

Visual intrusion

A motorway, because of greater size is intrinsically more intrusive than a railway or a canal. Both the motorway and its generated traffic accelerate the decline in the rural environment and the over-visiting of well-known beauty spots has become an acute problem. In towns lines of parked cars and delivery lorries detract from the visual amenity. Urban motorways, like the Westway in London, create a no-man's land of desolation which lasts years after the motorway has been completed.

*The L_{10} level is the noise level which is not exceeded for more than 10% of the day. Noise is measured in decibels (dB) which is a logarithmic scale and a doubling in noise is approximately the same as an increase of 10dB(A).

Summary

The major and most serious part of transport's environmental costs are caused by road transport, although in certain fairly limited areas like noise, railways and aircraft make a significant contribution. It is officially expected that many of the environmental costs of road transport will increase, but it is a widely held view that these costs are already too great. Nine out of ten people live in built up areas and it is here that these costs are most serious. Environmental costs are external costs in that they are not met by the user but by the community as a whole; by their nature they cannot be quantified in pounds and pence.

THE SOCIAL COSTS

Car ownership

One in two households in Great Britain (53%) have a car for their own use but this is only one car for every four people (25%). The increase in car ownership in the last 20 years has been:—

1955	0.07 cars per head
1960	0.11 " " "
1965	0.17 " " "
1970	0.21 " " "
1975	0.25 " " "

This increase in car ownership has been responsible for almost all the increase in passenger travel which increased by 55% between 1963 and 1973. In spite of the rise in the number of cars, car ownership is still closely linked with income and the 53% of households which have a car are by and large the wealthier families. Car ownership gives the owner more choice and it is possible, for example, to choose from a number of shops over a larger area than it is without a car. But one of the consequences of this is that facilities like shops tend to concentrate their operations, and to benefit from the economies of scale draw on a larger hinterland, thus restricting choice. Between 1961 and 1971 there was a 10% reduction in the number of shops in Britain.

Because of the rise in car ownership there has been a large increase in road building, which of itself generates more traffic. One thousand miles of motorway were constructed between the opening of the Preston by-pass in 1958, and 1971. New traffic is generated when the cost of travelling by road, in terms of time, is reduced. One aspect of traffic generation was examined by an American study which found that new road construction in Pittsburgh caused a redistribution of commuters' homes, the net result of which was that the distance commuted increased but the journey time remained the same. Thus, mobility is not the same as movement. Mobility can be best defined as "having access to people and facilities."³ Movement is merely the passenger mileage needed to accomplish a certain level of mobility. By changing the land-use pattern (the distribution of homes, jobs, shops and other leisure facilities) it is possible to alter either movement or mobility independently of each other. Conversely, a change in either movement or mobility usually implies

a change in the land-use pattern. In the 1960s it was accepted that planning should facilitate any desired movement, but this attitude is changing and it is now accepted by Government (but less frequently practised) that movement should be restricted in certain circumstances.

The non-car user

Access to cars is not as widespread as is often thought. There are large classes of the population, notably the poor, the old, the young, and the infirm, who do not have, or have poor access to, a car. Nearly half the households in Britain do not have a car at all, and even in those that do, car use is restricted by possession of a licence and car availability. 66% of males but only 25% of females have a licence. Licence holding also varies with age, and whereas 59% of adults between 30 and 59 have a licence only 15% of those over 65 have one. The typical car driver is fairly well-off, middle-aged and male. Holding a car licence does not in itself guarantee access to a car, and a recent survey in the Outer Metropolitan Area found that even in this region, with levels of licence holding and car ownership amongst the highest in the country, 30% of those in car owning households and 70% of housewives did not have a car for their everyday use. Although the family car clearly does benefit non-licence holders their freedom is frequently restricted by a dependence caused for example by a lack of public transport.

The consequences of increasing car ownership

The consequences of increasing car ownership are felt most keenly by those with no or limited access to a car. Traffic causes difficulties and unpleasant journeys for pedestrians and cyclists, causes unreliability in bus services and produces changes in the land-use pattern which makes the operation of public transport more difficult. These consequences combine to accelerate the growth in car ownership still further. Little is known of changes in pedestrian traffic since there are no national statistics but it is likely that it has declined as journeys have become more difficult and dangerous. One cause of the decline in cycling is almost certainly its increasing danger. Cycle traffic in 1971 was less than one half of that in 1962 but over the same period the accident rate increased by 25%. Increasing car ownership has caused public transport patronage to drop, which has in turn caused fare increases and subsidies for uneconomic services, and service cuts. Bus and rail fares increased by 61% and 51% respectively between 1953 and 1973 in real terms (over the same period the cost of running a car fell by a third). Public transport has been caught in a vicious circle, unable to operate economically, with its decreasing quality of service and increasing price causing still more car ownership.

Accidents

The accident rate for roads is higher than that for railways. In 1971 the death and serious injury rates for

road and rail were as follows:

Road: Death rate	31	} per 1,000 million passenger miles
Serious injury	367	
Rail: Death rate	8.6	}
Serious injury	12.4	

There is a curious air of resignation about the toll of road accidents. They are the principal cause of death for people between the ages of five and twenty-four. About 21 people are killed and 2,500 seriously injured every day on the roads and "if the present toll continues nearly half the children being born today will eventually die or suffer injury on the roads."³

In 1973 there were 7,400 people killed and 346,000 people injured in road accidents. In most years between 40% and 50% of road deaths are either pedestrians or cyclists. Varied safety legislation, the 70 mph speed limits, the drink and drive laws, increased seat belt wearing and better roads have tended to reduce the road accident rate but so far reductions in the number of accidents have always proved to be temporary, due to subsequent increases in traffic. The frequency of road accidents is related to the volume of traffic and the number of right and left turns in a given distance. Modern dual carriageways minimise these conflicting movements and help to reduce accidents. The severity of road accidents is a function of the speed and weight of the vehicles involved and the degree of protection that they afford. Thus heavy lorries have a higher ratio of fatal to injury accident rates than do light vans.

4. URBAN TRANSPORT

The problems of urban transport affect a substantial majority of the population. 90% of the people in Britain live in built up areas and 31% of the population lives in the 25 largest cities. The pattern of traffic in cities, associated with high density development, is a dense, complex one, made up of large numbers of short journeys. In London the average length of the journey to work by all forms of transport except walking is only 4 miles, despite the extent of long distance rail commuting.

Superimposed on top of this short distance journey pattern in large cities is a commuter belt of suburban development on the fringe of the city limits. This creates a large number of relatively long distance work journeys. In London the average length of the work journey by British Rail is 10 miles and by Underground 7 miles.

In large cities the demand for movement is so great and the supply of space for movement so limited that efficient use of space is essential. When the use of space is not efficient, or the demand for movement is too great, then congestion and overcrowding result. The car is the least efficient user of space even when full, but the 90,000 cars that enter Central London in the morning peak (7 a.m. to 10 a.m.) carry only 128,000 people, that is under 1.4 people per car. Public transport is a much more efficient user of space; 144,000 people enter Central London in the same period in 3,200 buses and a further 800,000 by train.

In Central London the existing road space is at capacity. There is more traffic than the roads were designed for and congestion results. This congestion is almost entirely caused by cars. In the example above, buses account for about 10% of the total traffic flow, but commuting cars account for 90% of the traffic, yet they carry fewer people. In Central London all the passengers entering during the morning peak could be carried in only double the existing number of buses.

Because there is a limited supply of road space in major urban areas the use of the car for commuting hinders efficient bus operation. In every other British city but London buses carry the majority of commuters to the central area and most cities now have bus lanes to help protect buses from traffic congestion. Traffic congestion does however force many would-be car commuters to use public transport and in all major cities there is more demand for car commuting than can be satisfied. There are two fundamentally different approaches to solving this problem. One, the government approach in the 1960s, was to increase the supply of road space so that all the desired car movement could take place. The second, which is current government policy, is to restrain car use.

The Buchanan Report *Traffic in Towns* encapsulated the official attitude towards the car in the 1960s. The central themes of this report were that cities and towns should be adapted and reconstructed to permit the maximum freedom of car use and that pedestrians and cars should be segregated, for safety reasons. Like the contemporary Beeching Report, the Buchanan Report was a product typical of its time: possession of a car was the ultimate individual freedom and restrictions on this freedom were unacceptable. In towns, where physical restrictions on the amount and quality of road space caused congestion and limited the cars' freedom of movement, the answer was to remove this limitation by increasing the supply of road space, to meet not only the present demand but the predicted future demand.

Following this report most towns drew up ambitious road schemes. In its 1970 White Paper *Roads for the Future*, the Government planned to increase its spending on urban roads, and especially urban motorways substantially. At the Greater London Development Plan Inquiry, the road scheme, with its four concentric ring roads, met with sustained opposition. For the first time a highway authority's road plans were effectively challenged on technical grounds by the London Motorway Action Group and the London Amenity and Transport Association. These groups argued that the roads would cause tremendous environmental and social damage and would not anyway solve the problem of congestion. Although Layfield reported broadly in favour of the proposals, the London Labour Party made opposition to the ring roads part of their election platform and won the 1973 elections. Many commentators felt that this was the decisive issue, and it proved to be a turning point in official policy towards urban roads. Urban roads are very expensive to build, because of the high cost of land, and reduce the housing stock in

areas where there are often already housing shortages. The emphasis on urban roads was attacked by the House of Commons Expenditure Committee in 1973 and in 1975 Tony Crosland, the Secretary of State for the Environment, rejected plans for York's inner ring roads because all alternatives had not been thoroughly explored. In an article⁴ in June 1975 he elaborated that he would be very reluctant indeed to approve urban road schemes in future because of the high economic and environmental costs.

The Buchanan report was the epitome of transport as an end in itself, and in barely a decade official attitudes have changed from favouring unrestricted car movement to accepting that this is neither possible nor desirable. The expense of building the urban roads envisaged by Buchanan would have been enormous and the construction of the inner ring road in London alone would have meant the demolition of 10,000 houses.

Even if the ambitious road plans that Buchanan envisaged were fulfilled, without additional traffic restraint there would be little benefit. In Nottingham it was conceded that at peak hours there would have to be traffic restraint even after building their £100 million road scheme, and only 40% of those motorists who wanted to use their cars at peak periods could have done so. The London Transportation Study showed that even after building the ringways in London the "increase in locally generated traffic (will largely (counterbalance) the beneficial effect of the removal of almost all through traffic from the area."⁵ In the urban situation where the demand for road space greatly exceeds the supply, traffic simply expands to fill any new road space and road construction is self-defeating.

Large scale road construction would not be desirable because car traffic would be generated, increasing at the expense of public transport. However, public transport (as seen in the central London example above), would remain essential for the journey to work in large urban areas and the continued erosion of its passenger traffic would make it hopelessly uneconomic. As was pointed out by Essex County Council in their Maplin City Consultation study, unrestrained car use in an urban area is incompatible with more than a skeleton public transport service, and even this would have to be subsidised.

The importance of walking as a means of transport is often under-estimated and it is usual to omit it in transportation studies. A 1970 survey in the London Borough of Southwark showed that most facilities were within 2 miles of home and that one half of leisure trips and one quarter of all trips between $\frac{1}{4}$ and 2 miles were made on foot. Like walking, cycling is also a more efficient user of space than the car. In the urban situation cycling can be as quick or quicker than a car, whilst providing a great degree of flexibility because of the lack of parking problems. The main drawbacks of cycling are the weather and the danger caused by other traffic. Even so, a survey in the London Borough of Lambeth found that cycle use had been increasing since 1971.

The bus, as was seen above, is an efficient user of space. The train is even more efficient at carrying more passengers. Fast trains carry long distance commuters into London from as far as Aylesbury or Basingstoke while in Inner London the underground railways, stopping at stations often less than a mile apart, run trains with a service frequency of less than a minute in peak hours.

Between the wars the Southern Railway (now British Rail's Southern Region) encouraged long distance commuting by a massive electrification programme, so that homes moved further away from London. This permanent market became a millstone when increasing car ownership caused a further change in the land use pattern: homes moved a car drive away from the commuter stations, thus removing the off-peak housewife market, and television removed the evening market. Now British Rail's London commuter services are hopelessly uneconomic even though paradoxically they are overcrowded in peak hours, because the vast amounts of capital and labour needed to operate this system for just two to four hours every day is largely unused for the rest of the day. To a lesser extent this same problem is shared by all public transport services. A major defect of public transport in urban areas is that services are largely designed to serve the work journey and leisure journeys are badly served.

Commuting has been increasing since the first world war with faster and faster trains and more recently with faster roads. These commuters, usually the more affluent, do not contribute to the city financially and can "disassociate themselves from its problems by living elsewhere."⁷ There is a real danger that British cities may follow the American example and become ghettos of the urban poor.

URBAN TRAFFIC RESTRAINT

Until recently traffic management was synonymous with measures designed to increase the effective road space, like the replacement of on-street car parking by off-street parking and the synchronisation of traffic lights to increase the traffic flow. It has now been realised that traffic management techniques can be used to restrain traffic selectively.

As soon as the demand for road space exceeds the road capacity, lower speeds and congestion result. Congestion in itself will restrain any further traffic growth and although fears were expressed in the 60s that without road construction traffic 'would grind to a halt' in our cities this has not proved to be the case. In Central London, although car ownership continued to increase, traffic flows did not increase after 1961 but dropped slightly. Most towns have traffic restraint through congestion but this is unselective and applies to all road users whereas through traffic management it is possible to have selective restraint.

It is usual to discriminate against the car commuter, firstly because there are usually alternatives to car commuting, secondly because car commuting is the

largest volume of traffic when the demand for road space is greatest, and thirdly, because this traffic is not as economically essential as goods vehicles. In London this is being done by reducing the number of parking meters, in themselves a fiscal restraint on car use. Road pricing has been examined but discarded as being impractical. Recently the GLC dropped a plan to impose supplementary licensing on journeys to Central London. A major problem in regulating car commuters is that they form an affluent and articulate body of opinion. And although governments can agree that commuters should be restrained, the implementation of these policies proves more difficult.

The environmental problems of road transport are most obvious in cities because they affect the most people and because traffic is the most dense. A reduction in urban traffic would achieve considerable environmental benefits. Many towns have created pedestrian precincts, areas from which traffic is banned, notably Nottingham, in which the central core has been virtually freed from traffic. The extent of the improvement, and in particular the lack of traffic noise is remarkable. Although this policy met with considerable opposition from traders when it first started its obvious success and the subsequent increase in business has pleased even the traders.

5. RURAL TRANSPORT

For urban transport, the fundamental problem, the conflict of the car and the environment, was one of the inability of the urban fabric to accommodate all the desired movement. Except in some instances, like popular beauty spots and market towns, there is enough road space in the country to permit the unrestrained use of the car because of the low density of development. The characteristic of rural transport is one of light traffic flows over longer distances than in towns because facilities are more dispersed.

The low density of population allows relatively high levels of car ownership and rural car ownership is higher than urban. However, a considerable proportion of the population, probably between one half and one third, remain dependent on the fast vanishing rural public transport. These people are largely the old, the young, the disabled, the poor, and women. Between 1930 and 1960 the country dweller attained a high level of mobility. This level has not been maintained and while the generally richer car owners have increased their mobility, this has been counter-balanced by a decline in mobility for a substantial section of the population. The 1961 Jack Committee on Rural Bus Services considered that "while the number of persons who experience hardship or inconvenience may be decreasing, the degree of hardship or inconvenience which they experience may tend to increase as services are reduced."⁶ Since 1960 rural public transport has declined dramatically. A 1971 official study of rural transport in Devon found that while household car ownership had increased from 44% in 1963 to 72% in

1971, there had been a simultaneous decline in public transport, and 210 miles of railway track and 82 stations had been closed between 1961 and 1971 leaving only 191 miles and 51 stations; and between 1955 and 1970 Western National had reduced its bus mileage by 25%, since when there have been even more drastic bus service cuts.

A rough estimate by the Independent Commission on Transport indicated that bus mileage in 1972 was one third less than it had been in 1956. Between 1959 and 1973 passenger railway routes fell from just over 14,000 miles to just under 9,000. The larger part of these public transport cuts were in rural areas. The number of passenger stations, again mostly rural, fell even more dramatically by 57%.

The collapse of rural public transport "isolated and impoverished the lives of many persons".⁷ People were left stranded as the tide of public transport receded. Spreyton, a village of 300 people in Devon has no public transport and almost every household has a car. The DoE report on transport in Devon made the cynical comment: "Clearly people have adapted to the absence of a bus; those who could not, presumably left some time ago. Those who have moved in, including retired people, have cars."⁸ Even so one fifth of the village would have used a bus service once or more times a week if there was one. The survey of car ownership showed that men were twice as likely as women to have a car available; that social grades AB (professional and managerial) were three times as likely as DE, (unskilled and agricultural), and age group 25-44 three times as likely to have a car as those over 65.

An important consequence of the lack of public transport has been a change in the social structure in the rural community with an increased proportion of professional and managerial grade residents. In the Devon study, referred to above, 20% were AB compared with the national average of 12.5%. This would seem to have been caused by car owners moving into the country and by non-car owners moving out, which raises the moral question of whether people should be forced to choose between having a—perhaps unwanted—car or moving house. Unwanted car ownership in rural areas caused by the lack of public transport has been a cause of complaint by the women's organisations for some time.

Although rural public transport is frequently uneconomic and often subsidised, the extent of savings made by closures is often small. In spite of the Beeching cuts in rail services, British Rail's finances have continued to deteriorate and one recent estimate⁹ suggested that all the rail closures since the Beeching Report (up to 1968) only saved £10 million annually. Another estimate suggested that restoring bus mileage to its 1956 level in 1972 would have cost £31 million annually, less any revenue from these services. The grant paid to British Rail for their largely rural services in 1972 was £29 million but the grant is officially acknowledged to over-estimate the savings that could be made by closure. The interdependence of

rail services was underlined by the results of a study for British Rail's Railway Policy Review, which showed that closing uneconomic services (mainly the rural and London commuter services) would not make the railway system profitable, because the traffic from loss-making railways help to support the profitable railways, and closure of the loss-maker can turn the 'profitable' railway into a loss-maker. Cuts in rail services have also caused a loss of traffic on profitable bus services which fed rural railways. Railway management has often been slow to make economies on uneconomic services, preferring instead to apply for a closure order and either get a grant or close the line. On the East Suffolk line, the introduction of pay trains reduced the cost of running the line from £250,000 a year to £84,000 and made it profitable.

When a rail service is closed a bus replacement service is usually required. These have not proved a very successful alternative. In practice, because the bus is slower than the train, traffic on the service is usually halved and many replacement services are withdrawn when the legal obligation (for three years after closure) to provide them expires.

While rural transport was contracting, shopping, medical and educational facilities were being centralised. One consequence of these mutually incompatible strategies has been that it is no longer possible in many rural areas to visit relatives in hospital by public transport. Hospital visitors, where public transport is impractical, are eligible for a travelling grant after assessment by the Supplementary Benefits Commission. This is just one example where savings in public transport subsidies have caused an increase in costs for another government department, in this case the Department of Health and Social Security. Local Education Authorities have to provide school buses and local authority social services are also called on for help. Lincoln County Council recently refused £33,000 for the retention of 13 bus services, but in 1971/2 £465,000 was spent on school transport.

Many people, especially the infirm who are an important group suffering 'mobility deprivation', find journeys to hospitals and doctors' surgeries difficult, either because public transport does not exist or because timetables are inadequate. A survey by the National Council of Women gave the example of a woman living in Clitheroe, who in order to attend Blackburn Infirmary was reduced to hitchhiking her lifts including milk floats and farm tractors.

The centralisation of shopping has meant the disappearance of many village shops. This is not a problem for the car owner but those without a car are entirely dependent on train or bus to reach the nearest town for the minimum needs of ordinary existence. A recent "innovation" in public transport, which is an updated version of the 19th century mail coaches, is the introduction of post buses. These will probably play a significant part in rural transport in the future. Most places without public transport do have postal deliveries, often several a day, and to carry passengers as well as

to collect mail involves only a marginal increase in cost. The drawback is that the timetable will suit the Post Office rather than the passengers, but this inconvenience is minor when compared with the lack of any service at all.

The Countryside Commission has been involved in a number of experiments to reduce car traffic in certain popular beauty spots. In Clumber Park, a cycle-hire experiment in 1974 was so successful that although designed to be subsidised it was in fact profitable. In the Goyt Valley traffic management scheme in the Peak District, car access has been made more difficult and a minibus service provided. The Settle to Carlisle railway line was reopened for passenger traffic on summer weekends and this too was profitable.

Rural work and school journeys are still adequately catered for either by public transport or by buses provided by the education authority, by firms or by car sharing. Those non-car owners who were not catered for after public transport withdrawals or those whose choice of school or work was restricted by the lack of public transport have moved. Shopping and medical journeys are often difficult but the main journey purpose with which most non-car owners experience difficulty is the leisure journey. Many of the bus services that do exist do not run on Sundays and buses rarely run late enough for restaurants, cinemas or theatres.

Increasing car ownership has caused severe 'mobility deprivation' in rural areas. It is difficult to see how rural public transport can survive if car ownership continues to increase, unless the Government is prepared to increase subsidies. If public transport is allowed to collapse there will be a migration of non-car owners to urban areas and a reverse migration of car owners to the country. This will cause considerable, and disruptive, change in rural society. A substantial proportion of the population will however continue to depend on what rural transport survives.

6. INTER-URBAN TRANSPORT

The proportion of rail, bus and car long distance journeys in 1973 was:

	25-100 miles	over 100 miles
Rail	9%	15%
Bus	6%	7%
Car	83%	74%
Others	2%	4%

The proportion of freight traffic by road and rail in 1971 was:

	Under 25 miles	25-49 miles	50-99 miles	over 100
Road	12.9	9.1	9.7	18.2
Rail	1.0	1.7	3.2	10.0

ROADS

Even though the car is the most important means of transport for long distance journeys the average journey length on motorways (20 miles) is surprisingly short.

Motorway construction, starting with the opening of the Preston by-pass in 1958, and the M1 in 1959, to the completion of the first 1,000 miles of motorway in 1971, encouraged longer distance car journeys. However, motorway construction has had far-reaching social and environmental consequences. Although the standard of motorway landscaping has improved since the construction of the M1, motorways are still visually intrusive and environmentally damaging because of their large land-take and the severance of agricultural land and communities.

The purpose of the 1,000 miles of motorway built between 1958 and 1971 was to connect the major urban centres and to remove congestion on inter-urban roads. But faster roads generate traffic: a study by the Road Research Laboratory on the M1 estimated that 30% of the traffic was generated by the motorway. Thus one consequence of the inter-urban motorway construction programme has been to increase traffic in urban areas. An important part of this generated traffic has been heavy goods vehicles and one result of the improvement of roads in the Midlands and the M2 has been a large increase in heavy lorries passing through London and small villages like Bridge on the way to Dover. A more general result has been to make road haulage more competitive with both rail and water and to cause a diversion of traffic from rail and water to road. In association with the development of roll-on roll-off lorry facilities (ferries on to which lorries can drive direct) there has been a tendency for foreign trade road journeys to be maximised and for the sea journey to contract.

The increase in heavy lorry traffic has also been encouraged by increases in the maximum speed limit, from 20 to 30mph in 1957, to 40mph in 1962, and to 60mph on motorways since 1959; by an increase in the maximum weight limit from 24 tons fully laden to 32 tons in 1964 and the relaxation of licensing requirements in 1968. These relaxations of the restrictions on road freight, coupled with the increasing reluctance of the railways to take the relatively unprofitable wagon-load traffic has caused a dramatic increase in both the number of heavy lorries and complaints about road freight.

Although the total number of lorries on the road has remained more or less constant, rising by 13% between 1963 and 1973, their average carrying capacity has increased markedly and the number of lorries with an unladen weight of more than 5 tons increased by 192%. The amount of traffic carried by heavy lorries has also shown a dramatic increase and whereas in 1962 only 35% of road freight was carried by heavy lorries (over 5 tons unladen) by 1973 this had risen to 79%.

THE RAILWAYS

The major achievement of the Beeching era with the railways, which is frequently overlooked, was the improvement in operating efficiency. The inter-city passenger service was a product of this era and in 1969

127 express trains averaged over 75mph (which was more than had averaged 60mph in 1939) and in 1969, for the first time since 1852 revenue from the passenger service exceeded that from freight. The electrification of passenger services proved very successful, the Kent Coast electrification generating more traffic than the anticipated 50 to 60%, and the London to Liverpool electrification increasing passenger journeys by 65%. Many of these passengers were captured from the air services and there was a drastic reduction in the frequency of the London to Birmingham air service. The success of British Rail inter-city services made them economic and the relatively high fares on these routes are used to cross-subsidise other services.

The railway freight services have not been so successful and traffic decreased following the Beeching cut-backs. This was partly due to external factors like the decline in the consumption of coal and coke by power stations (traditionally railway freight traffic), but also due to a decline in wagonload traffic. The Beeching doctrine was that the smallest unit of freight movement on the railways should be the train-load (capacity about 500 tons) and that wagon load traffic (capacity between 20-70 tons) was too small to be economic. Many relatively light loads were deliberately left to road haulage and there was surprising withdrawals of freight facilities at major traffic generators, like the traditional fish traffic at Fleetwood and Grimsby.

LONG DISTANCE BUSES

The long distance express bus is cheaper than the car and the train but unlike the train it cannot compete with the car for speed. Its market therefore tends to be restricted to cross-country services where rail links are of poor quality, or non-existent and to the poorer end of the non-car owning market. Car owners tend to prefer the train when they travel by public transport. Even so the bus performs a valuable role in improving the mobility of the poor and those for whom rail services are inconvenient.

AIR SERVICES

Internal air services have been affected by the improvements in rail services in recent years. Between 1953 and 1966, domestic air travel increased fivefold but since the completion of the electrification of the London to Liverpool railway, and later sectional strife in Northern Ireland, traffic remained static for several years. British Airways met the challenge of the London to Glasgow railway electrification in 1974 by introducing a no-booking, place-guaranteed shuttle service on this route. The main effect so far seems to have been for the two competing services to squeeze British Caledonian's service. Even though air travel is more expensive than either rail or bus many municipal airports are subsidised, Liverpool to the extent of £768,000 in 1972. Air travel remains relatively insignificant for inland transport and it accounts for less than half the passenger mileage of the pedal cycle.

COASTAL AND INLAND SHIPPING

Coastal shipping carries an extremely important proportion of inland freight. Railways and coastal shipping carry 37% of all freight traffic and the majority of all freight moved over 100 miles. Most of its traffic, like rail, tends to be large consignments of coal, oil and cement. Oil carryings have declined in recent years following the opening of a number of pipelines. Traffic declined from 15.2 thousand million ton miles in 1967 to 13.1 in 1971 while pipeline traffic increased from 1.0 to 2.0 thousand million ton-miles over the same period. Coastal shipping has also been hit by road haulage competition.

Inland waterways have considerable local significance. Traffic tends to be bulk cargoes like those carried by coastal shipping and rail.

FREIGHT—A GENERAL DISCUSSION

There has been an increasing tendency to tranship to road transport when cargoes arrive at port, at the expense of barge, lighter and canal traffic, even for waterside destinations. This has been caused not by the intrinsic advantages of road haulage, but rather by heavy investment in road haulage and a dearth of investment in water transport, reflecting the administrative chaos of this form of transport.

It is frequently claimed, especially by those who suffer from heavy lorries, that road freight should go by canal or rail. This is not possible. The vast majority of road freight is short distance hauls of less than 30 miles, some of them being rail freight deliveries. British Rail estimate that rail freight is only economic, apart from certain exceptions, on hauls of over 150 miles. However, a considerable proportion of road freight is carried more than 150 miles, much of it by heavy lorry, and it is this category of freight which is both environmentally damaging and which could be transferred to rail.

7. FUTURE DEVELOPMENTS

Transport consumes a substantial and increasing proportion of Britain's wealth, about one fifth of the national output, one quarter of oil imports and 14% of all consumer expenditure. Road transport accounts for the largest part of this consumption. Although only one in four people own cars they account for nearly 10% of all consumer expenditure. The energy costs of road transport are high and at present transport is almost entirely dependent on oil. The environmental and social costs of transport (and this is principally road transport) are very high. The consequence of the recent increase in spending on transport has been a deterioration in the environment and declining mobility for a large part of the population. Barbara Castle, then Minister of Transport said when introducing the 1968 Transport Act that she intended to 'make it possible for public passenger transport to survive both in the cities where it is being strangled and in rural areas

where it is being starved'. Despite her good intentions public transport services have continued to deteriorate and the dependence upon them by non-car owners suffering 'mobility deprivation' has increased. The increase in car ownership is closely linked with a worsening of conditions for pedestrians and cyclists as well as the decline in public transport. When mobility is considered from the viewpoint of having access to people and facilities it is apparent that a surprisingly large part of the demand for movement can be satisfied by relatively short journeys and walking remains the most important, and the most used form of transport for all journeys.

For the future there are two fundamentally incompatible options. The first is to allow and provide for the maximum possible car ownership with a consequent increase in the economic and resource cost of transport. Two subsidiary options follow from this; either to subsidise public transport to an unprecedented degree or to countenance its disappearance from rural areas and a residual skeleton public transport service in urban areas, which would restrict the mobility of a large proportion of the population to probably unacceptable levels. The second major option is to restrain car ownership at a desirable level which could be at, above, or below the present level, so as to have desirable levels of mobility, of public transport and public transport subsidies and an acceptable level of environmental and social disturbance. A third option, which is largely independent of the foregoing, is to plan the land-use pattern so that the need for movement is minimised and mobility maximised; and a fourth possibility is that new technology may widen the choice between the two main options. A quiet car for instance would enable an increase in car ownership whilst allowing a decrease in noise.

A similar set of options exist for road freight transport:

- a) to facilitate the maximum possible increase in freight transport in general or road transport in particular;
- b) to restrain freight movement and in particular road freight to a desirable level.
- c) to plan the land use pattern so that freight movement is minimised.

Current government policy is to restrict urban car use for the work journey, but not to restrict ownership, although any restriction in use for a substantial part of the population does imply restrictions on car ownership.

The five-fold increase in the price of oil since the Arab-Israeli war has prompted some fundamental re-thinking in transport. However, one view, held mostly by road planners, is that this price increase is but a minor hiccup and that prices will fall to a more 'realistic' low level, with incomes again continuing to grow faster than car running costs. The other view is that the Arab-Israeli war was a watershed in the world energy supply and that never again will energy be so cheap as it has been in the post war period. The rise of the motor was accompanied by a movement from a high energy cost situation in transport to a high labour

cost. This has caused public transport difficulties because of their traditionally high manning levels. The view is taken that we are now reversing this change and returning to a relatively high energy cost situation. The explorations manager of BP has predicted that world energy production will peak in 1983, and decline thereafter. It is likely therefore that the price of petrol will rise considerably and that this will restrict the future growth in car ownership unless alternative fuels are found.

Several alternatives to petrol are practical: chiefly electric propulsion by battery, hydrogen, methanol and liquid fuels from coal. Methanol is probably the most likely alternative fuel and being cleaner than petrol it would reduce vehicle pollution. It is however likely to be considerably more expensive than petrol has been in the recent past.

PERSONAL RAPID TRANSIT

There has been considerable investment and interest in semi-experimental PRT networks in recent years. Several versions are being promoted, amongst them the Transport and Road Research Laboratory's mini-tram. In essence PRT is a highly automated, fixed network with small capacity vehicles with about the capacity of a passenger car. Lacking the car's advantage of flexibility and having most of the car's disadvantages it is difficult to understand its popularity. The 'mini-tram' was rejected—to the embarrassment of the Transport and Road Research Laboratory—in a structure plan exercise in Sheffield in favour of improvements to the existing rail system. An extremely expensive network at Morgantown University, West Virginia, built with federal funds, could only carry its student passengers at slightly above walking pace and tenders have now been invited for its demolition. It would have been both cheaper and quicker to have given each student a bicycle.

The bicycle has the greatest potential for development in urban areas. With between 11 and 13 million bicycles in Britain, and low resource and environmental costs, the bicycle, as Ernest Marples, a former Minister of Transport, said, has 'a great future providing the conditions are right.'

LIGHT RAPID TRANSIT (LRT)

Much development of public transport is likely to centre around the existing bus and rail systems, but one of the most promising innovations of recent years has been light rapid transit—what used to be called trams. Its essential features are a lightly constructed fixed track network with generally light weight rail cars either running alone or linked in twos or threes. A 1973 OECD report expressed the belief that LRT "represents a major breakthrough in the search for less expensive, environmentally compatible transport systems that could serve economically the relatively well-dispersed travel patterns of today's urban areas."

LRT is an intermediate between bus and train, being

faster than a bus yet more economical to operate than a train. It is doubtful whether any other city in Britain could afford an underground system like London but most major cities would have enough traffic for an LRT network. LRT operates in many major European cities and the Tyne and Wear Passenger Transport Executive will operate the first in Britain, linking several loss-making railway lines by a tunnel in Newcastle city centre. This precedent of up-grading the existing rail network is likely to be followed by other British cities and there is also the possibility that LRT could be applied with advantage to loss-making rural railways.

BUS DEVELOPMENTS

The post bus experiments have already been mentioned, and the future direction of many public transport developments is likely to be one of matching the capacity more closely to the traffic, like LRT. More frequent services encourage increases in passenger traffic and one way of achieving this at little or no extra cost is to run smaller and lighter vehicles. The National Bus Company has been running a mini-bus experiment in Abingdon and London Transport another one in Hampstead Garden Suburb.

TRAFFIC RESTRAINT

One of the most important experiments in traffic restraint is taking place in Nottingham, where a 'collar', consisting of traffic lights on the main roads to the city centre, is being thrown around one half of the city. If the experiment proves successful, this will be extended around the whole city. When the traffic flow in the morning peak on the major roads leading to the centre reaches such a level that congestion will result if it continues, the traffic lights on these roads turn red, for up to ten minutes at a time, to reduce the flow. However, traffic is prevented from congesting the main radial roads by more traffic lights on roads which feed the main road from housing estates which also turn red, thus bottling up the excess city bound traffic in the housing estates. Priority is given to buses by bus lanes; park and ride facilities⁸, a car park and a city centre bus service are provided so that motorists can avoid any hold-ups. This cleverly designed scheme could prove to be a major breakthrough in urban car restraint and public transport priority.

FREIGHT

As energy costs increase it is likely that freight will tend more and more to use the more energy efficient forms of transport. Coastal shipping in particular has considerable potential for expansion provided that concentration facilities can be organised for containers. An increasing proportion of the longer haul freight traffic is likely to come by coastal or inland shipping and rail, with an increased use of containers. Road transport is still likely to be used for the local distribution of goods rather than for trunk hauls. One possible

development that could alter freight transport radically is the containerised airship—but this has yet to prove itself.

CONCLUSIONS

The future could hold considerably more promise than the recent past, with the prospect of a real improvement in our environment and in what is often called the 'quality of life'. Transport is a means to an end, that of providing people with goods, services and mobility, and can only rarely be an end in itself. The emphasis on encouraging indiscriminate and unrestrained movement has for many people frustrated the purpose of transport.

8. STATISTICS

Passenger movement in Great Britain

Units: Thousand million passenger miles

Year	Air	Bicycle	Rail	Bus	Car/taxi/ motorcycle
1955	0.2	11.3	23.8	49.8	54.3
1960	0.5	7.5	24.8	43.9	89.4
1965	1.0	4.4	21.8	39.2	144.7
1970	1.2	2.6	22.2	34.1	189.9
1973	1.5	2.2	21.9	38.8	223.5

Goods movement (unit: ton miles)

Year	Pipelines	Inland water	Coastal shipping	Rail	Road
1955	0.1	0.2	12.7	21.5	23.0
1960	0.2	0.2	13.4	18.7	30.1
1965	0.8	0.1	15.3	15.4	42.1
1970	1.8	0.1	14.2	16.4	50.8
1973	2.1	0.1	12.6	15.6	56.0

Road goods transport, by size of vehicle used (ton miles)

	1962	1970	1973
Under 5 tons unladen	65%	31%	21%
5 to 8 tons	24%	37%	30%
over 8 tons	11%	32%	49%

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Biographical note on the author

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